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Signed R. Mahoney

Dated 26 November 2003

Patents Form 1/77

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12SEP03 E836763-1 D02820
P01/7700 0.00-0321324.6

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road
Newport
South Wales
NP10 8QQ

1. Your reference

P03974GB

2. Patent application number
(The Patent Office will fill this part in)

0321324.6

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

UVGI SYSTEMS LIMITED
47 CENTRAL AVENUE
WEST MOLESEY
SURREY KT8 1QZ

Patents ADP number *(if you know it)*

08711616001

If the applicant is a corporate body, give the country/state of its incorporation

GB

4. Title of the invention

STERILISATION OF SURFACES

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

LAURENCE SHAW & ASSOCIATES
Metropolitan House, 1 Hagley Road
Edgbaston
Birmingham B16 8TG

Patents ADP number *(if you know it)*

13623001

6. Priority: Complete this section if you are declaring priority from one or more earlier patent applications, filed in the last 12 months.

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
GB	0224427.5	21.10.02
GB	0224897.9	25.10.02

7. Divisionals, etc: Complete this section only if this application is a divisional application or resulted from an entitlement dispute (see note f)

Number of earlier UK application	Date of filing *(day / month / year)*

8. Is a Patents Form 7/77 (Statement of inventorship and of right to grant of a patent) required in support of this request?

Answer YES if:

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.

Otherwise answer NO (See note d)

Yes

Patents Form 1/77

9. Accompanying documents: A patent application must include a description of the invention. Not counting duplicates, please enter the number of pages of each item accompanying this form:

Continuation sheets of this form	
Description	9
Claim(s)	0
Abstract	0
Drawing(s)	4 + 4

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent (Patents Form 7/77)	
Request for a preliminary examination and search (Patents Form 9/77)	
Request for a substantive examination (Patents Form 10/77)	
Any other documents (please specify)	

11. I/We request the grant of a patent on the basis of this application.

Signature(s) LAURENCE SHAW & ASSOCIATES Date Sep 11, 03

12. Name, daytime telephone number and e-mail address, if any, of person to contact in the United Kingdom

LAURENCE SHAW : 0121 454 4962

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Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 08459 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

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e) Once you have filled in the form you must remember to sign and date it.

f) Part 7 should only be completed when a divisional application is being made under section 15(4), or when an application is being made under section 8(3), 12(6) or 37(4) following an entitlement dispute. By completing part 7 you are requesting that this application takes the same filing date as an earlier UK application. If you want the new application to have the same priority date(s) as the earlier UK application, you should also complete part 6 with the priority details.

Agent's Ref: P03974GB

STERILISATION OF SURFACES

The invention relates to the sterilisation of surfaces, particularly floor and wall surfaces.

It is known to provide a so-called vacuum cleaner which is moved over a floor either manually by motor power and has brushes which sweep up debris on the floor or remove material adherent to the floor and which are then passed in a vacuum system into a collector. It has been realised that the brushes can become contaminated and in addition to washing them, it has been suggested to sterilise them. Ultraviolet light radiation has been proposed for this purpose.

It is known to use ultraviolet light radiation to kill airborne pathogens. It is also known that such pathogens can reside on surfaces and a separate step is required to destroy or control them on the surfaces. It is an object of this invention to provide apparatus for use in cleaning the surface of a floor or the like which will sterilise that surface as well as the intended brushes. Such a device would be useful in the case of cleaning of floors in hospitals, mortuaries, schools and toilet areas, food preparation areas and the like.

In one aspect, the invention provides apparatus for cleaning and sterilising the surface of a substrate, the apparatus comprising a vehicle arranged to move over the surface, the vehicle containing brush means, fan means and an ultraviolet light source, the brush means being arranged to release dirt adherent to the surface, the fan means being arranged to draw a current of air from the region of the surface into

the vehicle and to a collection vessel to receive the released dirt, and the ultraviolet light source being arranged to sterilise the surface cleaned and the brush means.

Preferably the apparatus includes a plurality of ultraviolet light sources having one or more shield members about each light source to reduce deposition of air-borne detritus on the UV light source. Preferably each shield member is made of a UV transparent material. Preferably the UV transparent material is made or quartz or fused silica. Preferably each shield member is a tube disposed about the UV light source. Preferably each shield member is detachable from the light source for cleaning purposes.

Preferably the power supply to the light sources is individually controlled.

Preferably a heat sink is associated with each light source.

Preferably, the UV light sources are UV lamps, emitting light in the UV-C band (typically 254 to 280 nm). Suitable UV lamps are elongate tubes, it has been found that for good effect the lamps should have a non-circular cross-sectional shape, say oval with flats. This increases the effective area of radiation. Preferably the lamps are arranged in banks, say each of four lamps. Preferably the mean level of radiation is about 10 milliwatts.

The lamps may be located in a chamber which has reflective wall surfaces, such as quartz mirrors, or polished aluminium or the like.

A component made of a material which releases hydroxyl ions known to be detrimental to pathogens may be present. Such a material may be a metal oxide such as titanium dioxide.

The invention will now be described, by way of example only, and with reference to the accompanying diagrammatic Figures in which:

Figure 1 is a section through one apparatus of the invention;

Figure 2 is a perspective view of a first embodiment of UV light unit in the apparatus of Figure 1;

Figure 3A is an elevation of a second embodiment of UV light unit in the apparatus of Figure 1;

Figure 3B is a view along line A-A' of Figure 3A;

Figure 4A is an elevation of a variation of the second embodiment of UV light unit of Figure 3A;

Figure 4B is a view along line B-B' of Figure 4A.

The vacuum cleaning apparatus shown in Figure 1 comprises a housing A having front wheels B and a push handle C. The underside of the housing has an open throat D leading to a fan unit E and thence to a collection bag F. The throat D contains a rotary brush G. Ultraviolet light units H are present, one at the leading side of the throat D and the other at the trailing end. The units may take different

forms, as shown in the following drawings and are arranged to project ultraviolet light on the substrate 5 being cleaned and on to the brush G.

Referring next to Figure 2, each ultraviolet light unit H comprises a chamber 2 containing a series of quartz sleeves 3 (13 being shown, but the number may range from say 8 in two banks each of 4 lamps). A UV-C lamp 4 is located within each sleeve 3. At one end of the chamber 2 there is mounted an electrostatic filter 5 across the inlet to the chamber 2. Below the filter 5 is a UV screen 9. The filter is arranged to give particles a static charge. At the other end of the chamber 2, across the outlet thereof, there is mounted a HEPA filter 6.

The lamps are arranged to emit light in the UV-C band of about 254 nm. The output is about 10 milliamps/cm^2 mean level, and a heat sink is present to keep the temperature at about 100^0C.

Two opposed walls 20, 21 of the chamber 2 have a concave inner surface, the other two walls 22, 23 being planar. Walls 20, 21 are formed from, have applied thereto, or are coated with aluminium, which is polished or shiny to enhance the UV reflectivity of the walls 20, 21. The planar side walls are similarly treated.

In use, air is drawn or pushed through the Unit H in the direction of arrow X by the flow of air in the housing A. This air is pre-filtered by the electrostatic filter 5 to remove relatively large particulate material and enters the chamber 2 where it is irradiated by the UV-C lamps 4. It will be appreciated that the UV-C radiation is emitted through 360° and, because of the number and arrangement of the lamps, maximum irradiation of the incoming air is ensured. The UV-C light is also reflected from the walls 20, 21, 22, 23 to ensure complete irradiation of the space defined by

the walls 20, 21, 22, 23. The concave surfaces of walls 20, 21 act as parabolic reflectors to the UV-C radiation. As the air is drawn or pushed through the chamber the transported viruses, mould and bacteria are killed or rendered inert by the actinic radiation. Some of the lamps are directed on to the substrate S and others on to the brush G.

The electrostatic filter may be formed of a UV transmissible material. It may also have one or both of its major surfaces coated with an anti-microbial or biostat substance.

After passing through the UV irradiation zone, the air is finely filtered by the HEPA filter 6. Any organisms which have not been affected by the UV-C radiation, are trapped on or in the HEPA filter 6. The HEPA filter element 61 is preferably made from a UV transmissible material such as glass fibres. Therefore, any trapped bacteria, mould or virus undergoes further irradiation, ensuring that it is rendered non-viable. The HEPA filter element 61 may be held in place by a frame 62. Preferably, the frame 62 is fabricated from a combustible material, such as wood. Once the nominal lifetime of the filter 6 has elapsed, the whole filter 6 may be removed and incinerated. The frame 62 makes it easy for an operator to remove and replace the filter 6. Another filter may be present, e.g. of carbon particles.

During operation of lamps 4, there is a tendency for a static field to build up, which usually attracts dust and dirt particles. These fall on the sleeves instead of on the lamps 4. The sleeves 3 also ensure that a degree of turbulence is induced into the air flowing through the chamber 2.

It will be appreciated that to change a lamp 4 during routine maintenance it is unnecessary to turn off the power to all of the lamps 4. The emissive part of each lamp 4 is within the chamber 2, thus an operator may simply disconnect the power supply to the lamp 4 which is to be changed and slide that lamp 4 out of its respective sleeve 3. The procedure is reversed to install a new lamp. This is advantageous because there is reduced down-time for the apparatus and during lamp replacement there is a reduced risk of exposure of the operator to UV-C radiation.

During routine maintenance of the apparatus 1, the sleeves 3 may require cleaning. To do so it is necessary to cut off power to the unit 1. The sleeves 3 can then simply be removed and wiped clean.

It is a feature of the invention that when the apparatus is switched off the lamps are energised for about 5 minutes and continue to operate after the fan is switched off. This reduces the risk of injury to the operator. Dual safety circuits and UV-C protected inspection windows are present to confirm that lamps are switched off.

In use, the operator pushes the apparatus along the floor and using controls not shown, activates the vacuum. The brush G rotates to clean the surface S. Air is drawn into the throat D and the particles collect in the collection unit F. Air passing into the units H is treated by the ultraviolet radiation and then joins the main stream. Radiation is directed downwards to sterilise the surface of the substrate S, so killing any micro-organisms on the substrate. (Switches, not shown, may be present so that the units H are energised once the apparatus is moving and deactivated when movement stops.)

Figures 3A and 3B show a second embodiment of UV unit 101 having a chamber 102 mounted within which elongate UV-C lamps 104 (8 being shown), are circumferentially spaced about the inner periphery of the chamber 102, with their axes parallel to that of the chamber 102. A quartz sleeve 103 is mounted co-axially within the chamber 102, the lights being located between the sleeve 103 and the wall of the chamber 102. If it is desired that a greater intensity of UV light is to be directed to the centre of the chamber 102, a quartz focussing lens 110 may be located adjacent each lamp 104.

An electrostatic filter 105 is mounted across the inlet to the chamber 102. At the other end of the chamber 102, a HEPA 106 extends across the outlet.

The internal surface 123 of the wall of the chamber 102 is formed from, is coated with, or has placed thereupon aluminium, which is polished.

Mounted upstream of the electrostatic filter 105 is a fixed blade fan 130. The fan 130 induces turbulence in any air which flows thereby.

In use, air is drawn or pushed through the unit 101 in the direction of arrow Y by the fan E. The air is pre-filtered by the electrostatic filter 105 to remove relatively large particulate material. The air passes by the fan 130 which induces turbulence in the air flow, which air then enters the chamber 102 where it is irradiated by the UV-C lamps 104. The UV-C light is also reflected from the walls 123 to ensure complete irradiation of the space defined by the sleeve 103. As the air is drawn or pushed through the chamber 102 viruses, mould and bacteria are killed or rendered inert by the actinic radiation.

The electrostatic filter 105 may be formed of a UV transmissible material such as glass fibres. It may also have one or both of its major surfaces coated with an anti-microbial biostatic coating.

After passing through the UV irradiation zone, the air is finely filtered by the HEPA filter 106. Any viable mould, bacteria or viruses which have not been killed by the UV-C radiation, will be trapped on or in the HEPA filter 106. The HEPA filter element 161 is preferably made from a UV transmissible material such as glass fibres. Therefore, any trapped bacteria, mould or virus undergoes further irradiation, ensuring that it is rendered non-viable. The HEPA filter element 161 may be held in place by a frame 162. Preferably, the frame 162 is fabricated from a combustible material, such as wood. Once the nominal lifetime of the filter 106 has elapsed, the whole filter 106 may be removed and incinerated. The frame 162 makes it easy for an operator to remove and replace the filter 106, and aids in the incineration process.

During operation of lamps 104, there is a tendency for a static field to build up, which usually attracts dust and dirt particles. The sleeve 103 prevents the build up of dust or other detritus on the lamps 104.

Figures 4A and 4B show a variation of the apparatus of Figures 3A and 3B, wherein identical components are indicated by the same numerals with the addition of a prime (').

The apparatus 101' has all of the components previously described with the exception of the lamps 104. In the apparatus 101', a series of toroidal or omega shaped lamps 204 (8 shown) are located along the major axis of the chamber 102' in

the space defined between the quartz sleeve 103' and the inner wall of the chamber 102'. As will be appreciated, operation of apparatus 101' accords with that of 101.

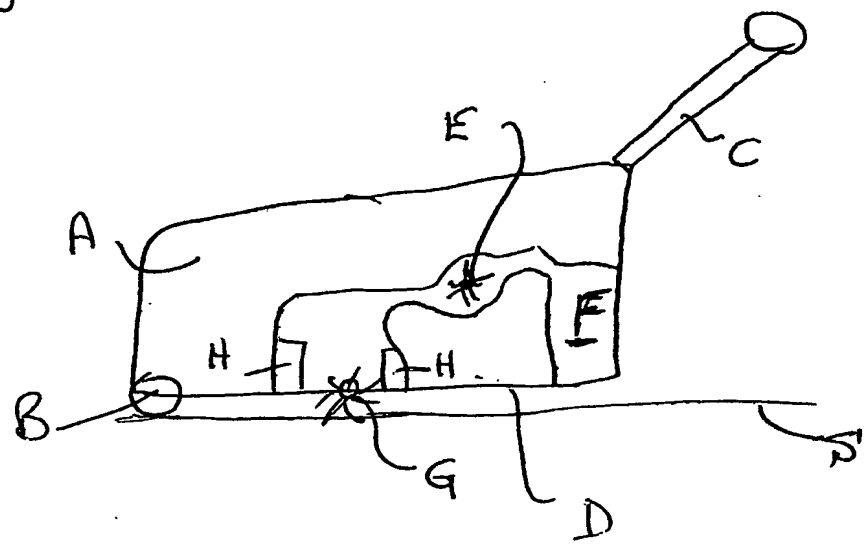
The apparatus 1, 101, 101' may be used to clean air in a fixed system, such as those used in buildings, vehicles and the like, wherein air from, say, a room is exhausted via ducting which is connected to the inlet of the apparatus 1, 101, 101'. The so-cleaned air is then returned to the, say, room either directly or via a further air conditioning plant, for example a heat exchanger to warm or cool the air.

Several air-cleaning apparatus 1, 101, 101' may be connected in parallel so that cleaning or routine maintenance of one may be carried out whilst the others are operating.

The invention is not limited to the embodiments shown. A carbon filter may also be present at the outlet. Devices to generate ozone, electronic controllers may be present to monitor the temperature of the lamps and intensity. The apparatus may be powered, e.g. by an electric drive unit. The apparatus may include a polishing or buffing pad to treat the cleaned sterilised surface.

Agents Ref
P03974GB

Fig 1



Agents Ref P039746GB

~~1/4~~ ~~2/5~~ 2/4

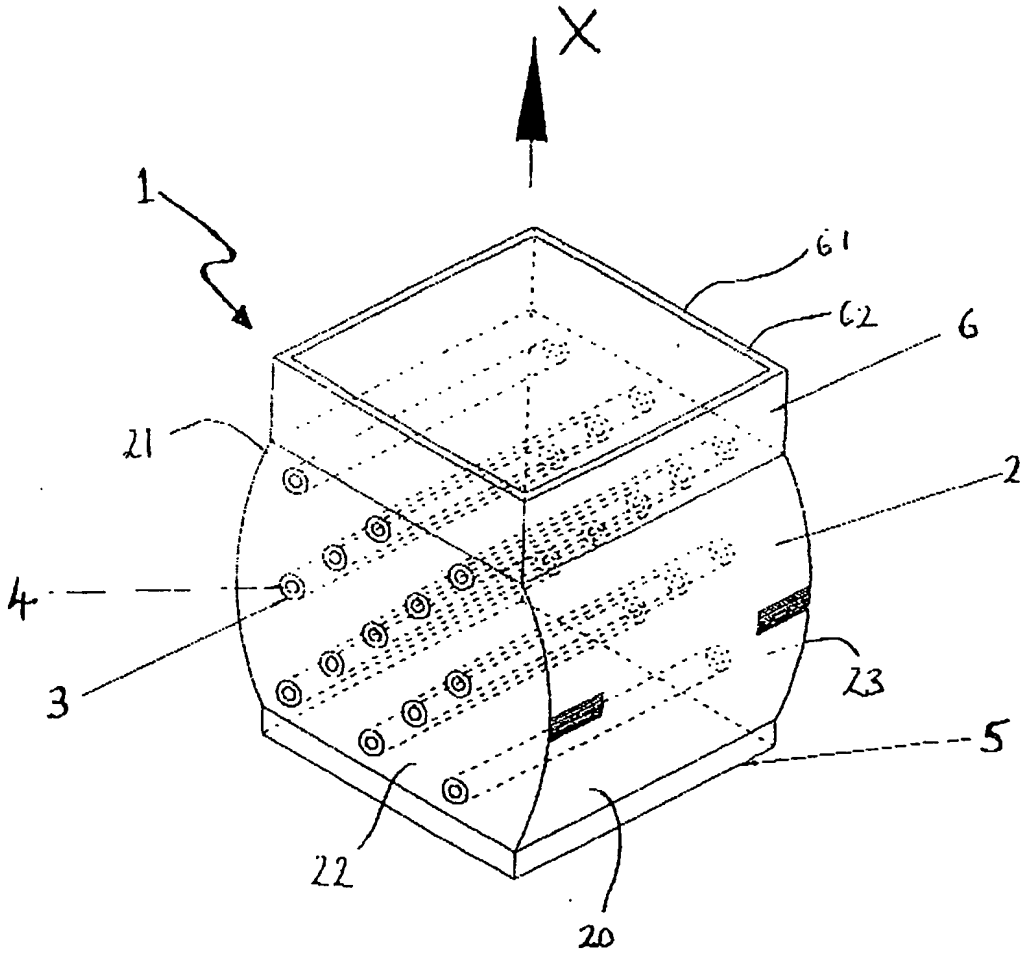
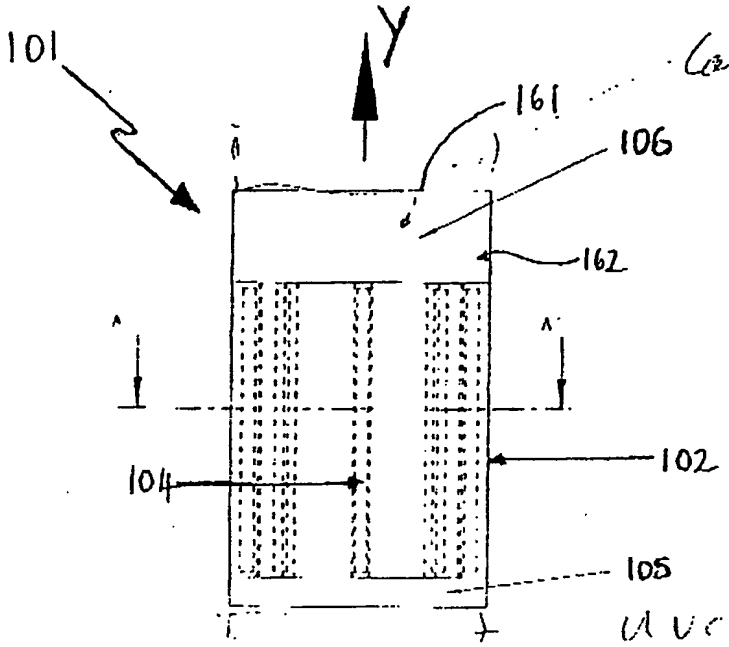


FIGURE ~~1~~ 2.

Agents Ref P03974B

~~2/4~~ ~~2/5~~ ~~2/4~~ 3/4



Carbon

UV Reflective/Shroud

FIGURE ~~2A~~ 3A

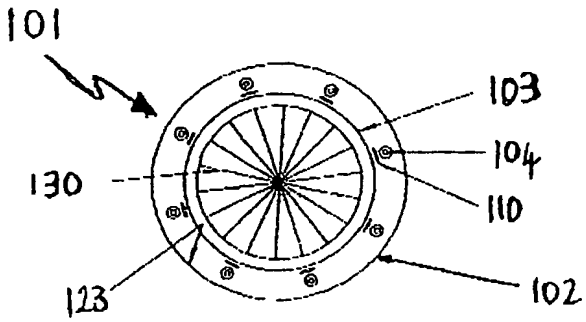


FIGURE ~~2B~~ 3B

Agents Ref P03974GB

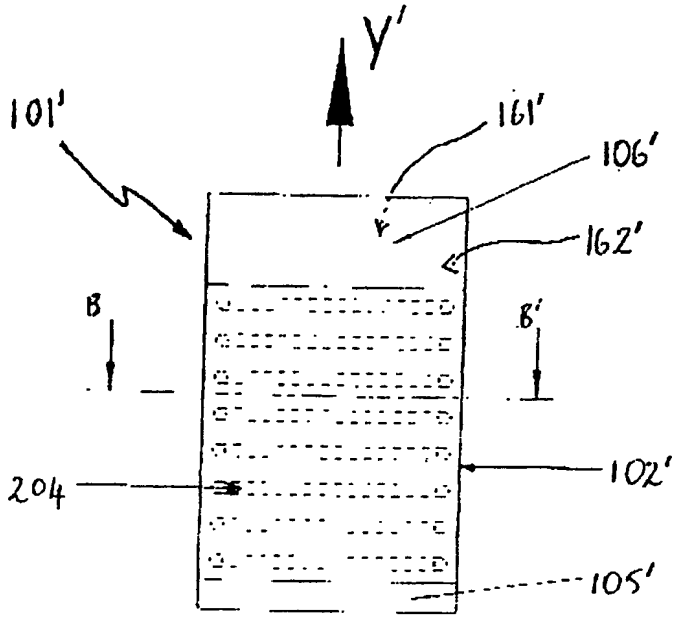


FIGURE 4A

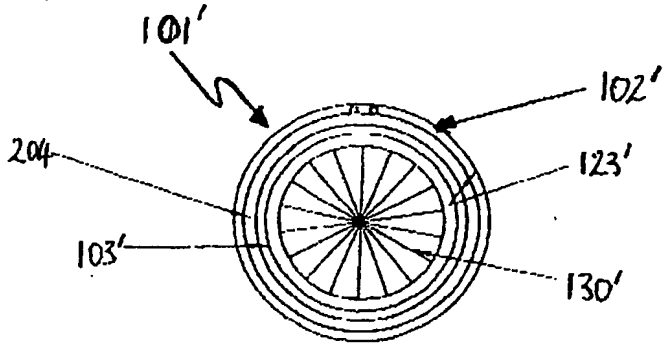


FIGURE 4B

PCT Application

GB0304540